
Hubs versus Hub--Nots: A Comparison of Various U.S. Airports

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ABSTRACT

The purpose of this paper is to examine possible differences between hub and non--hub airports. The authors gathered both primary and secondary data on the 100 busiest U.S. airports. This study uses passenger levels, current capacity, and other variables to analyze possible differences based on airport type. The authors hope to stimulate discussion by government officials, airport authorities, and academics concerning airport policy decisions.

INTRODUCTION

Deregulation of the airline industry has changed the way companies do business. Many of the benefits are positive, for instance lower fares and more choices (Smith, 1995). Deregulation has also contributed to the dramatic increase in the number of passengers throughout the system. Many airports have struggled to handle these additional 300 million passengers a year (Lack, 1988).

Another of the major impacts of deregulation is the creation of major airport hubs. Alfred Kahn, an expert on deregulation, stated that the hub--and--spoke system is a direct economic result of reduced government control (Kahn, 1990). Deregulation helped to create an environment where major airlines benefit by using the hub system (Fawcett and Fawcett, 1988).

However, there are possible negative side--effects to shifting to a hub--and--spoke system. The hub airports experience tremendous growth in operations. This may cause various problems such as increased delays, additional noise, and dissatisfied customers. Important questions are how various airports are addressing the problems of delays, funding, Federal Government regulation, and lack of capacity, among other issues needed to be addressed.

Based on the hub--and--spoke concept, the authors defined a ``hub" airport as an airport that acts as a hub for a class 1 carrier such as Delta at Atlanta Hartsfield or American at Dallas--Ft. Worth. Given the increased numbers and importance of hub airports, there are many questions that need to be addressed. This article

examines some of the differences and similarities between various airports. After a brief examination of the relevant literature, the research questions are presented. The results section highlights the findings of an airport survey. Finally, conclusions and possible research opportunities are presented.

OVERVIEW OF THE LITERATURE

A striking point concerning the literature is a lack of articles dealing specifically with hub type airports. The most relevant articles appear in practitioner journals such as *Aviation Week & Space Technology* (O'Lone, 1989; Phillips, 1994), *Air Transport World* (Reingold, 1995), and *Airliners: The World's Airline Magazine* (US Air's, 1994). Many of these articles do not deal with "hub" type specific issues, but rather use hub airports as examples of current operational procedures or problems.

An alternative to "hub" specific articles lies in the related airport literature. Most of these articles deal with critical issues that affect the large, hub-type airports. These articles have two common themes: capacity and expansion.

The hub airports are faced with ever increasing numbers of passengers and aircraft operations. As noted in the introduction, there has been a huge growth in passenger traffic since deregulation. Based on Federal Aviation Administration (FAA) growth predictions of 3.5 percent, the total number of annual enplanements will be over 640 million by the year 2005 (U.S. Department of Transportation, 1994). This is a 263 percent passenger growth in the thirty-five years following deregulation.

Much of this expansion is concentrated in the major hub airports. It is not surprising that the four busiest airports in the U.S. are all major hubs: Chicago, O'Hare; Los Angeles; Atlanta, Hartsfield; and Dallas-Ft. Worth. These four airports are predicted to have 152,213,000 enplanements in the year 2005 (U.S. Department of Transportation, 1994) and will account for approximately one-quarter of all passenger enplanements in just a few years. Considering the increasing number of people moving through these and other hubs, the busiest airports are attempting to identify methods to respond to the escalating number of passengers and flights.

While practitioner publications discuss some hub issues, academic journals present a number of relevant articles about capacity and expansion issues. Fawcett and Fawcett (1988) discuss airport expansion and present possible alternatives. They suggest the best alternative in the short-term is to restrict access by raising landing fees. Also, they imply that a long-term solution would be to add capacity if possible (U.S. Department of Transportation, 1994).

Another related study was conducted by Bishop and Thompson (1992). They examined the relationship between peak-load pricing and airline scheduling. Their findings provided empirical support for Fawcett and Fawcett's study. Bishop and Thompson found that raising landing fees did alter the flight opera-

tions of smaller, charter-type carriers (1992). They recommended peak-load pricing as an effective method to handle the increased demands on airports.

A third study combined academia, practitioners, and government employees. The National Research Council of the Transportation Research Board presented a special report discussing all of the options available to prepare airports for the projected increases in passengers (1990). Unfortunately, this work merely presented a laundry list of possible options. It did not present a clear recommendation to prepare for the increased numbers of riders. It did, however, provide weak support for expansion.

Finally, detailed examination of this issue was conducted by the FAA. Much like the previous work, they examined all the possible alternatives. They, too, did not make any recommendations, but rather presented the benefits and costs of numerous alternatives. This study provides a very descriptive analysis of the current situation (U.S. Department of Transportation, 1994).

While these studies do not directly address the hub-and-spoke system, they examine an issue which is critical to the major hubs. They provide background to compare whether and, if so, what differences occur between hub and non-hub airports. Numerous variables, such as number of delays, capacity expansion, numbers of passengers, provide excellent opportunities to perform comparisons.

RESEARCH QUESTIONS AND METHODOLOGY

A number of research questions were designed to examine not only the possible differences between hub and non-hub airports, but also the current techniques in use to reduce delays. However, the primary focus of this article remains the examination of the hub airports.

Two distinctive types of data were collected for analysis. First, secondary data was gathered from government sources on all major airports in the U.S. This included most of the basic demographic information normally collected in a survey.

Primary data was also collected using a two-page questionnaire. The survey was mailed to the airport or operations manager at the 100 busiest airports in the U.S. based on 1992 enplanements. With one exception, the format followed the traditional Dillman survey approach of a cover letter with a survey and return envelope (1978). This was followed with a reminder card the next week. Finally, a follow-up letter with survey and envelope was sent the third week. The exception was that the survey itself was not in the normal small booklet format. The goal was to increase the response rate by providing a survey that could be easily faxed back. The survey was printed on two pages on white paper and included a prepared fax cover sheet which included the return address of each respondent.

Using this research plan, 100 surveys were sent to the 100 busiest U.S. airports. Seventy-four airports returned the questionnaire (74 percent). Also, by surveying the population of the 100 busiest airports, any possible selection bias

was eliminated. However, it was necessary to test for respondent bias. Since secondary data for all 100 airports was available, it was used to compare the 74 respondents to the 26 non--respondents to test for bias.

Using Pearson's chi--square test for goodness of fit, the airports were compared using number of enplanements and number of delays. There was not a significant difference between the two groups (Enplanements $P=.8397$; Delays $P=.2223$). Therefore, it is reasonable to conclude that the respondents are representative of the population.

The data were collected to answer five research questions. The first question lays the foundation for the research. It also provides an excellent opportunity to examine the demographics of the respondents.

H1: There are demographic differences between hub and non--hub airports.

At first this appears to be obvious. The common perception is that hub airports are the large, busy airports like O'Hare. However, it is important to validate what appears to be common sense. Also, the other demographic variables include locations, delays and number of airport types. Table 1 provides summary data of the demographic findings where there are significance difference between hub and non--hubs. Appendix A provides an overall summary of the respondent airports.

The research confirmed the "obvious" points of hubs being larger and experiencing additional delays. The hub airports averaged almost seven million more

Note: Delays from 1 = "No Delays" to 3 = "Delays are a daily problem"

TABLE 2
Airports Expansion of Busiest U.S. Airports, 1996.

<i>Is your airport expanding?</i>	<i>% Yes</i>	<i>% No</i>
Total	84.9	15.1
Hub	94.4	5.6
Non-Hub	81.8	18.2

passengers a year than non--hubs. Also, they had a much higher number of fifteen minutes or longer delays each year.

Based on the findings about size of hub airports and the number of delays, the issue of expansion is extremely important to hub airports. Therefore, one could reason that hub airports would consider expansion to be a critical issue. The second research question compares airport expansion.

H2: Hub airports are more likely to expand capacity than non--hub airports.

Table 2 indicates the vast majority of airports (84.9 percent) report that they

<i>Primary Reason</i>	<i>Hub</i>	<i>Non-Hub</i>
Anticipated growth	5	36
Reduce delays	12	2
Attract new carrier	0	2
Modernize facilities	0	5
Not Expanding	1	10
Non-response	0	1

are currently expanding their infrastructure. However, there is not a significant difference between hub and non--hub airports ($P=.1989$). Therefore, it appears that all airports are very likely to be in the process of expanding their capacity.

This finding does not appear logical given the comparisons in delays and passenger volumes in hub versus non--hub airports. However, it may be because non--hub airports are being proactive in addressing capacity problems. They hope the current expansion will allow them to avoid the delays experienced by hubs due to the increasing number of passengers. Another possible explanation is that the non--hub airports are attempting to become hub airports by providing incentives to airlines to either relocate or add flights.

Since most of the airports are adding capacity, there may be subtle differences between the reasons or funding for the expansion.

H3a: There are no differences between airports' reasons to expand.

H3b: There are no differences in funding sources between hub and non--hub airports.

There is a significant difference between hub and non--hub airports' reasons for expanding ($P=.0000$). The hub airports are attempting to reduce delays at their locations. The non--hub airports are constructing capacity for future increases in passengers. Also, seven of the non--hub airports are building to either modernize their facilities or to attract an airline to add service at their location.

<i>Source</i>	<i>Total %</i>	<i>Hub %</i>	<i>Non-Hub %</i>	<i>P-Value</i>
Federal Government	34.5	32.1	35.2	.7036
Bonds	26.3	23.6	27.2	.6421
Airline Fees	13.9	22.0	11.1	.0782
Passenger Facility Charges	12.2	10.4	12.9	.7080
Industry	8.1	10.0	7.5	.5955
State Government	5.5	2.6	6.5	.1235

TABLE 4
Evaluation of Alternatives to Reduce Airport Congestion, 1996

No hub airports are adding capacity for either of those reasons. Table 3a summarizes the airports' primary reason for expansion.

The other part of the research question addresses the sources of funding for airport expansion. While there appeared to be some minor differences between hub and non--hub airports, there was not a significant difference among sources at the .05 level. However, hub airports were more likely to fund expansion with money collected from the airlines at the .10 level. Table 3b presents an overview of the various sources of funding.

In Table 3b, the only area with a statistical difference (at the .10 level) was the use of airline fees. Currently, hub airports generate less of the revenue from airlines on a percentage basis. This presents a possible opportunity as a future revenue source. However, this may also be due to concessions given by the airport to attract or keep the airline's hub operations.

Reduce landing intervals	4.327	4.412	4.354	.936
Add runway(s)	4.108	4.765	3.875	.048
Restrict landings	3.106	3.059	3.122	.629
Build new airport	2.683	2.529	2.739	.420
Raise landing fees	2.615	2.588	2.625	.356
Shift operations to another airport	2.318	1.471	2.630	.016
Provide alternatives to air travel	2.318	2.765	2.152	.190

Note: Ranked as 1="strongly against" to 5="strongly for"

TABLE 5
U.S. Airports Willing to Provide Incentives to Attract Service, 1996

The overall results of this research question are mixed. There is a significant difference between hub and non--hub airports' reasons for expanding. Even though they are adding capacity for different reasons, there is not a significant difference between the sources of funding for that expansion with one exception.

Although there are different reasons for expansion, most of the airports are building to either reduce current or future delays. Therefore, the next research question examines alternatives to expansion as a method to reduce current and projected congestion.

H4: Hub and non--hub airports differ about methods preferred to reduce congestion at their location.

Two questions presented seven options to reduce delays. The first asked the airports to rank order the seven options from best to worst. The second required the respondents to evaluate the same seven options using a five point Likert scale with one being "strongly against" to five being "strongly for."

The survey questions identified the same overall order for the options. Only the Likert results are presented to save space. Table 4 shows the airports' views of the alternatives.

Yes	18	5	13
No	56	19	37

The most popular choice is to reduce the landing interval between aircraft. This would increase the efficiency of airports and reduce congestion. The second most popular choice is the construction of additional runways. This option is much more popular with the hub airports than with the non--hub airports. The other alternative that has a significant difference is to shift traffic from airports with numerous delays to other airports. The concept of shifting traffic is much more popular with the non--hub airports that believe they would gain additional airline service during the expanse of the hub airports.

A last research question addresses what airports will offer to attract airline services. Since there are significant differences over the desire to relocate traffic, it is important to examine if non--hub airports are actively pursuing traffic from hub airports.

H5: Non--hub airports are more likely to offer incentives to attract new air carriers than hub airports.

Considering the previous research questions, it would seem likely that the non--hub airports would want to attract service. Along the same vein, the hub airports would not want to add service and the corresponding increases in traffic and delays. The research does not support this theory. Table 5 presents the findings of the airports that are willing to provide incentives to attract airline service.

The majority of airports are unwilling to provide incentives to attract service. This is also true of both hub and non--hub airports. Furthermore, there was not a statistical difference between the two groups' responses ($P=.6277$). Almost twenty--five percent of the airports are willing to provide incentives. Hubs are

almost as willing to provide incentives as non-hubs. airports. This does not appear logical given the problems of capacity and delays currently faced by hub airports. The probable cause of this apparent inconsistency is that airport officials want to protect and add to the size of their airports regardless of possible congested-related consequences.

The five research questions examine the differences and similarities of hub and non-hub airports in a number of settings. The demographic data identifies that the hub airports are significantly larger and experience more delays.

Despite the differences, there are a number of similarities between the hub and non-hub airports. The second and third research questions find that both types of airports are expanding and funding that expansion from similar sources. However, the third research question also identifies a significant difference in the reason that airports expand: hubs to reduce delays, non-hubs to meet future needs.

When additional alternatives are included, again there are similarities and differences between airport types. Both groups agree on many of the options. However, there are differences when runway construction and shifting traffic are examined.

Finally, there are no differences between the groups' willingness to attract airline service. In both groups, a minority of airports is predisposed to provide incentives to entice airlines to shift service to their location.

CONCLUSIONS AND OPPORTUNITIES

The research presents a mixed set of findings. While hubs and non-hubs differ in some areas, they still have much in common. Therefore, it is difficult to draw broad, sweeping conclusions about airports based on type.

The first conclusion is based on the size of hubs. Non-hub airports that become hubs (e.g., Cincinnati, Orlando) are likely to experience tremendous growth and eventually the related problems in capacity and delays. This is an important point that airports attempting to attract service should consider.

Another conclusion that policymakers should consider is the desire of airports to attract service. It may not be appropriate for large hub airports to add more flights until additional capacity is completed. Some smaller non-hub airports are willing to act as hubs. These airports may provide better service and reduce delays throughout the system. Government officials should examine whether this solution would improve travel.

A final point is the level of expansion. Nearly all the airports were in the process of expanding. At the same time, there is not a single new major airport under construction. It appears that Denver International Airport will be the last hub or non-hub airport opened in the foreseeable future. Given this assumption, the methods employed to reduce or prevent delays at existing airports will become more important. It is unclear whether system wide expansion will remain a vi-

able solution in an era of shrinking budgets. Hubs will be particularly affected due to their tendency and preference to build additional runways.

While this study successfully compares the hub and non--hub airports, there are a number of opportunities for future study. There are a number of additional comparisons that may be made between hub and non--hub airports. The effects of hubs on airline ticket prices have already been studied in detail. However, other possible areas would be the impact of customer satisfaction with the airport services, number of delays or number of direct destinations. Also, another possible study is a comparison of the various airports' management structures. Finally, there is an opportunity to study the economic impacts of hubs on local communities, gate rental rate and airline relocation decisions.

In closing, the authors would like to thank all of the airport managers that took the time to respond to the pilot study and the final survey. We appreciate the time and effort provided by these individuals. We hope to continue studying in this area of aviation.

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APPENDIX A
SUMMARY OF DEMOGRAPHICS OF
BUSIEST U.S. AIRPORTS, 1996

<i>Variable</i> <i>cent</i>	<i>Response</i>	<i>Number N=74</i>	<i>Per-</i>
Airport Type:	Hub	18	24.3
	Non--Hub	56	75.7
	Total	74	100.0
Airport Size:	Small (under 1 million enplanements)	15	20.3
	Medium (1 to 4 million enplanements)	31	41.9
	Large (over 4 million enplanements)	28	37.8
Delays:	Few (less .1%)	47	63.5
	Moderate (.1 to 1%)	18	24.3
	Heavy (over 1%)	9	12.2
Region:	Northeast	14	18.9
	Midwest	15	20.3
	South and P.R.	24	32.4
	West and Pacific	21	28.4